FE status
22 September 2016

(Update the since the presentation at the last 3x1x1 meeting of August 25th)

D.Autiero

1) 13/9-16/9 (Dario, Edouard, Slavic) **completed the installation of the FE cards on the 4 chimneys of the 3x1x1** and of the LV distribution system. We have been fully testing the entire chain (pulser, anode, flat cables, cold flange, FE card, flat cables on blade, warm flange) individually for all channels with pulsing via the strips with a 1 mip signal. All FE cards had been previously tested at IPNL and had no problematic channels.

2) Pulser tests identified 5 channels with problems: x1 chimney_1, x2 chimney_2, x1 chimney_3, x1 chimney_4). Debugging tests were performed by swapping the blades to check that the problems were not related to the blades. The problematic channel on chimney_1 was fixed by Cosimo inside the cryostat (flat cable connecting the anode was not well inserted) .

3) The grounding system was not yet installed last week and at the beginning of the FE cards installation there were bad noise conditions which could go from 3-30 mV depending on how the scope was grounded, cable paths and with manifestly large ground loops going trough the strips. The major contribution to the ground loops was identified in the big cables connecting the LED and the heathers. The cables of the heathers have common ground with the strips inside the cryostat but had not yet been put to ground on the slow control racks.

Work on the grounding system continued during the week by the group of Nicolas with the connection of the copper strips on the grounding paths.
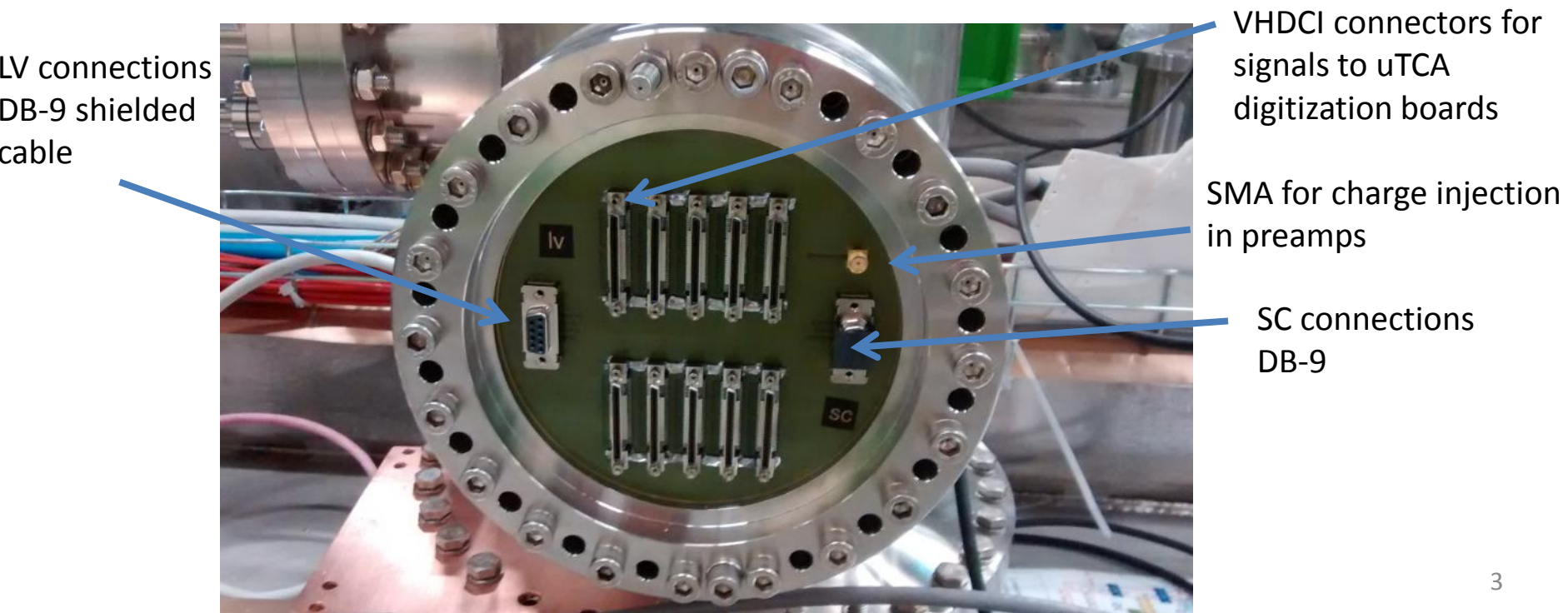
On Friday noise was back equivalent to July at <~mV level. Should further improve when grounding is properly completed

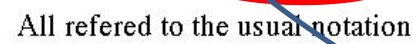Installation of grounding is being completed this week
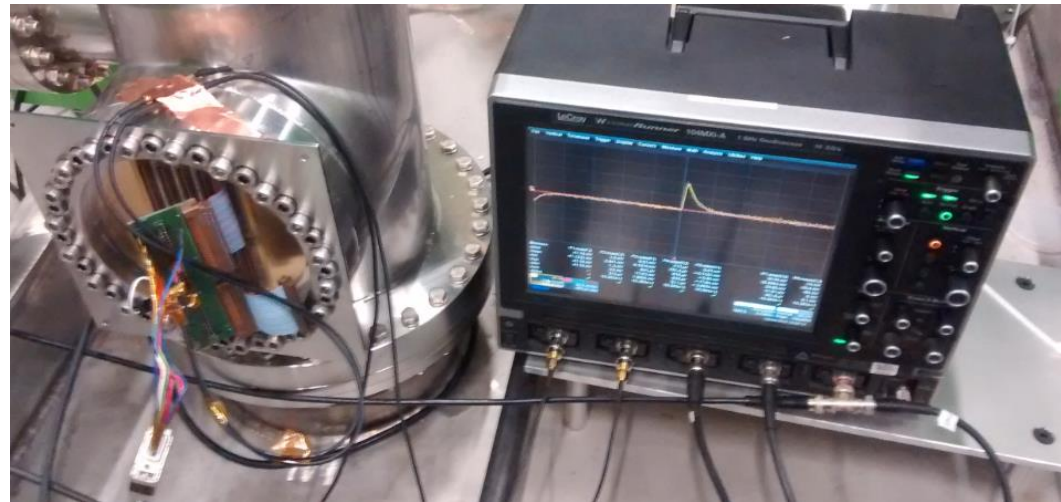
4) The warm flange PCBs from ELTOS arrived in Geneva on September 13th but were trapped at the airport for some customs problems. The welding of the connectors (KEL, VHDCI, SUB-D, SMA) was organized to be performed on Wednesday 14th morning by the CERN PCB service but it had to be delayed. They could start working on the first PCB on Thursday morning and this was delivered on Thursday around 16:00.

The PCB was installed with the help of Franco on the flange of chimney_1 on Thursday evening. It was then systematically tested for all channels. It works nicely, following expectations, from the mechanical and electrical point of view and it improves the grounding. We are really satisfied by the design of the PCB and by the PCB fabrication by ELTOS. Two connectors legs badly welded were detected in the pulser tests (missing one of the two polarities on differential output) on chimney_1 repeated with the new flange. The two bad welding have been already fixed by the CERN service. In between Friday and yesterday the other 3 PCBs had the connectors welded and they are being installed to replace the old flanges on chimneys 2,3,4.

LV connections DB-9 shielded cable

VHDCI connectors for signals to uTCA digitization boards

SMA for charge injection in preamps

SC connections DB-9

3

5) By crossing the list of malfunctioning channels with the one filled by Laura we realized that the cabling on the 3x1x1 connects different portion of the detector to the same read-out unit (FE card/digital card) of 64 channels. The 64 readout channels are not connected to 64 consecutive channels but to two groups of 32 channels separated by 50 cm, on two different LEM. This is related on how the flat cables from the anode are connected to the bottom of the cold flange feed-through

This is not a problem however it make a bit unnatural hardware related studies, for instance noise level on different cards or if there is a FE card or a digital card with a problem we will see on the display two stripes separated by 50 cm. We should try to have on the 6x6x6 FE units always associated to groups of 64 physically contiguous channels.

6) We will discuss next week with Cosimo, once he is back, how to finalize the SC system for the pulsing/calibration and provide some help with Edouard in completing the design and commissioning of the relays switchers that Cosimo is developing

7) uTCA digital cards : the PCB subcontractor of the company producing the PCBs and assembling the uTCA cards had an accident on a machine of the PCB production line, 4 PCBs out of 20 did not pass the QA tests and their production had to be relaunched. The delivery date for the 20 cards (see last meeting) was expected to be September 22nd . The company by taking into account the PCB accident rescheduled the delivery of the cards from September 22nd to October 4th. We applied a big pressure by saying that this delivery was not acceptable with respect to our schedule and that at least the 16 good cards should have been delivered by September 22nd and the other 4 cards with PCB problems as soon as produced.

The company was not immediately proposing this solution since setting up the production line for two different batches has an overcost. Finally they agreed that the PCB subcontractor had to pay the assembly overcost of 800 euros due to the PCB delay and organized the production of the first 16 PCBs by September 22nd and the remaining 4 on September 30th. This has been maintained and actually slightly anticipated, the expedition of the first batch happened yesterday with one day of advance. We received the cards one hour ago …

8) As mentioned at the last 3x1x1 meeting the digital cards hardware was tested in August by Claude to give the green light to the production of the other 20 cards but the firmware (developed and tested on the demonstrator card of 2015 based on the S4AM, ALTERA STRATIX IV FPGA) does not run in an automatic way on the cheaper FPGA dimensioned for the final card (ALTERA Cyclone V) but needed some adaptations. This had never been the case with the other FPGAs used in past cards developed for this project since 2006: Arria and STRATIX ALTERA series.
Some important differences in the new FPGA Cyclone V are corresponding to additional parameters to adjust electrical levels, for example a pull-up level for the initialization of the ADCs did not have the default value as in the past FPGA, similarly the levels for the transmission of the ethernet signals had to be adjusted.

Claude has been putting a lot of efforts on the firmware adaptation work and today the ADC readout part of the firmware works fine as well as the firmware which handles the timing functionalities.

The ethernet firmware for data transmission is still under debugging. It was necessary to change the FPGA parameter to adjust the electrical levels of the signals. The signals of the data frames have been checked on the uTCA backplane with a fast digital scope (bits signals are at the ~ns level) and are now undistinguishable to the ones of the previous cards, which do not have data packets transmission problems. Still some problems affect the ethernet transmission of the new card.

The MCH switch declares that the ethernet link with the card is up and functioning in a stable way. The card works well in reception but the packets produced by the card are systematically dropped by the switch in the MCH, even if the counting of CRC and BER is zero.

The debugging tools on the NAT MCH are not very developed and do not provide enough information, it would be nice to have a tool for a raw dump of the detected packets to know the reasons of the rejection by the switch. We have been putting pressure on the NAT support on this point and also the ALTERA support is involved in debugging the problem.

9) On Thursday last week Jacques and Bruno came to CERN in order to perform the preparation of the uTCA crates and their integration in the DAQ network with the optical transceivers and the 20m long fibers. The 10 Gbit network connection from the MCH to the DAQ network works fine. The configuration procedure is being replicated on the other 3 crates (see the presentation by Thierry). There is an annoying feature which is being sorted out with NAT: in the default configuration the crate management communication does not go through the same 10Gbit optical link that we set up for the data but assumes another 1 Gbit copper link. It is annoying to deploy an additional copper network and also not indicated in order to avoid complicating the grounding scheme. Jacques is sorting out this configuration aspect with NAT

10) We set up a system to test the event builder/writing on disk in Lyon before getting the full batch of uTCA cards and the complete DAQ system. The DAQ system is entirely network based with the uTCA digitization boards seen as IP nodes. → Written a software which emulates the boards by sending simulated data of an event seen by each board. Set up a network structure+ event builder were a few PCs (one PC for each uTCA board in the DAQ) running the emulation software reproduce the DAQ flow from the uTCA boards.

Bruno and Slavic have been setting up the system which is working. The event builder receives correctly the data from the cards, some final debugging is actually going on the written data file and its readout with QSCAN.

11) The DAQ farm configuration has been advancing well with Thierry and Denis (see Thierry presentation). The disks raid optimization is in progress. The installation of EOS, metadata server and of the batch system has to be completed.

12) Elisabetta last week came to CERN for the installation of the reconstruction software on the online processing farm. This was performed on a temporary space since the disks/machines configuration was not yet stable. This installation will have then to be probably moved.

The software and working environment installation was completed. It is working nicely reproducing results in tests jobs already obtained at the computing center (see next slides).

Elisabetta is working on the implementation of xrootd in qscan which is necessary in order that the batch workers can see the data files on the distributed storage servers via the metadata server.

- The software has been installed (reconstruction code and needed external libraries)

- The working environment has also been set up

```
[epennacc@lxplus0059 ~]$ ssh -X prod@wa105admin
Password:
Last login: Fri Sep 16 14:50:44 2016 from wa105cpu0001.cern.ch
[prod@wa105cpu0001 ~]$ ls -rtl
total 1941892
-rw-r--r--. 1 prod wa105daq 1988488635 Sep 14 19:43 test_14Sept.tgz
drwxr-xr-x. 8 prod wa105daq       4096 Sep 16 12:36 test_14Sept
[prod@wa105cpu0001 ~]$ cd test_14Sept
[prod@wa105cpu0001 test_14Sept]$ ls -rtl
total 9276
-rw-r--r--.  1 prod wa105daq    2385 Sep 14 09:54 printenv.listing
drwxr-xr-x.  3 prod wa105daq    4096 Sep 14 10:13 xrootd
drwxr-xr-x. 40 prod wa105daq    4096 Sep 14 10:30 root-v5-34
drwxr-xr-x. 24 prod wa105daq    4096 Sep 14 11:25 WA105Soft
-rw-r--r--.  1 prod wa105daq     193 Sep 14 12:31 setenv.sh
```

- To test the installation, a sample of 10K cosmic events, in the 3x1x1 geometry has been reconstructed and benchmark distributions have been produced BOTH on the farm machine and at the CCIN2P3 → the 2 sets of benchmark distributions have been compared and are identical

```
-rw-r--r--. 1 prod wa105daq 144844352 Sep 14 13:31 recotask_WA105_cosmics_3x1x1_10000.root
-rw-r--r--. 1 prod wa105daq    201330 Sep 14 13:59 bench_recotask_WA105_cosmics_3x1x1_10000_pass1.listing
-rw-r--r--. 1 prod wa105daq     10450 Sep 14 13:59 bench_recotask_WA105_cosmics_3x1x1_10000_pass1.root
-rw-r--r--. 1 prod wa105daq    201330 Sep 14 13:59 bench_recotask_WA105_cosmics_3x1x1_10000_pass11.listing
-rw-r--r--. 1 prod wa105daq     21761 Sep 14 13:59 bench_recotask_WA105_cosmics_3x1x1_10000_pass11.root
-rw-r--r--. 1 prod wa105daq    201330 Sep 14 14:00 bench_recotask_WA105_cosmics_3x1x1_10000_pass12.listing
-rw-r--r--. 1 prod wa105daq     36798 Sep 14 14:00 bench_recotask_WA105_cosmics_3x1x1_10000_pass12.root
-rw-r--r--. 1 prod wa105daq       839 Sep 14 18:39 WA105_rectasks.config
[prod@wa105cpu0001 Qscan]$ pwd
/home/prod/test_14Sept/WA105Soft/Qscan
```
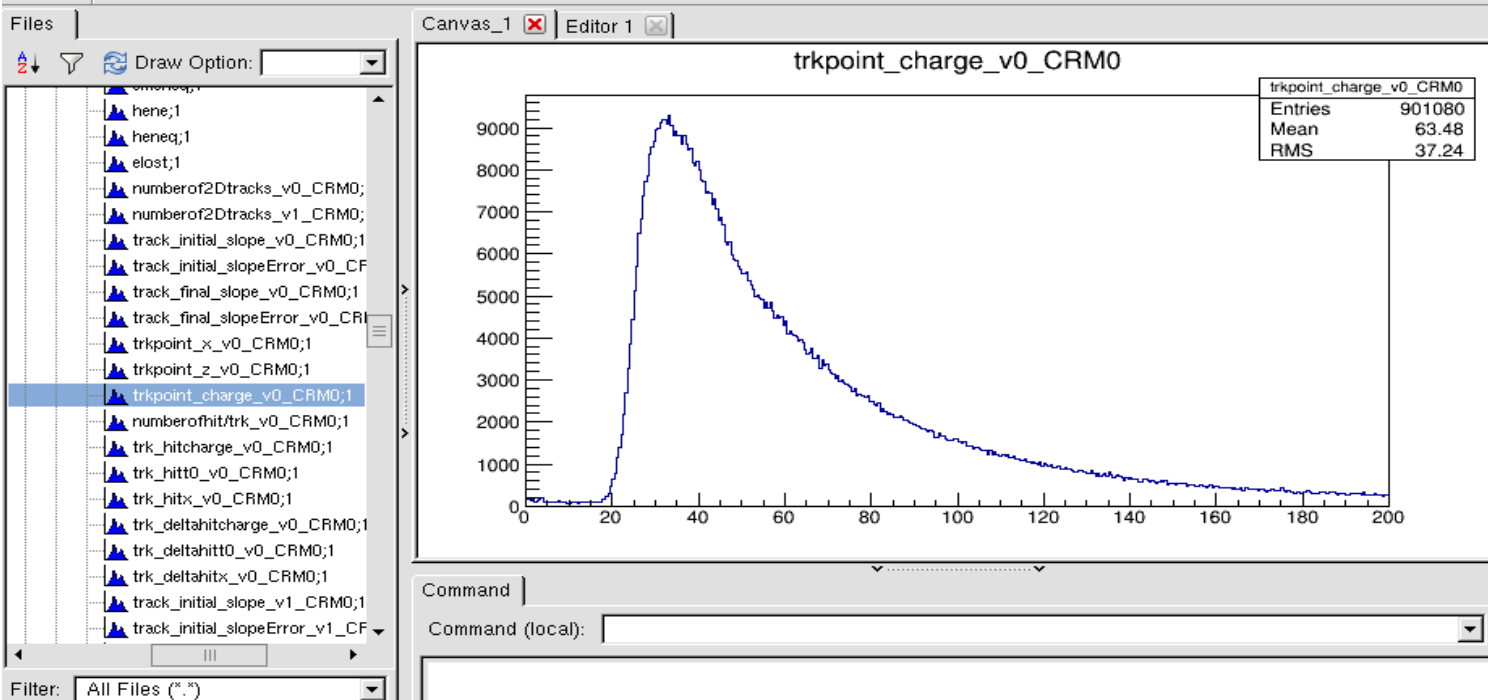
as example, charge distribution of the points belonging to the track is shown in the next slide:

charge distribution of the points belonging to the track
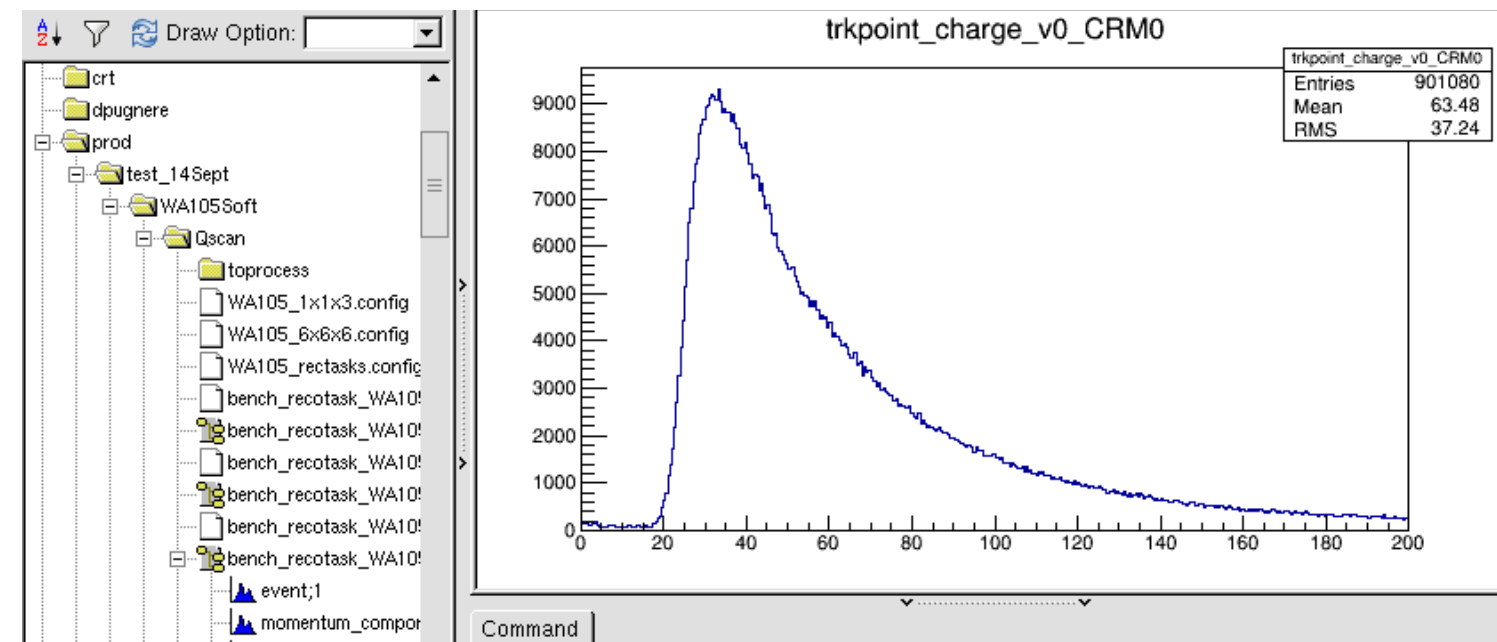
Online farm

ccin2p3

- Last but not least, the event display has also been tested, and it works